

Claims

1. A liquefied gas fuel supply device for a diesel engine characterized by comprising:

a fuel tank for reserving liquefied gas fuel;

an injection pump for delivering liquefied gas fuel to a fuel injection nozzle of a diesel engine;

fuel supply means for delivering the liquefied gas fuel from the fuel tank to the injection pump; and

remaining fuel retrieving means for retrieving liquefied gas fuel remaining in the injection pump to the fuel tank, after the stop of the diesel engine,

the remaining fuel retrieving means being constructed to cause forced circulation of the liquefied gas fuel in the fuel tank back so as to again return the liquefied gas fuel to the fuel tank through an aspirator, and retrieve the liquefied gas fuel remaining in the injection pump to the fuel tank by suction force produced in a suction port of the aspirator by the forced circulation,

the suction port of the aspirator being disposed at a position lower than an area in the injection pump in which the liquefied gas fuel remains.

2. A liquefied gas fuel supply device for a diesel engine characterized by comprising:

a feed pump for pressurizing liquefied gas fuel in a fuel tank to a predetermined pressure and delivering the liquefied gas fuel to a feed pipe;

an injection pump for delivering the liquefied gas fuel in a fuel gallery into which the liquefied gas fuel delivered via the feed pipe flows, to an injection nozzle of a diesel engine by a predetermined amount at predetermined timing;

an overflow fuel pipe for returning to the fuel tank the liquefied gas fuel which overflows from the injection pump; and

remaining fuel retrieving means for retrieving to the fuel tank the liquefied gas fuel remaining in the fuel gallery and the overflow fuel pipe, after the stop of the diesel engine,

the remaining fuel retrieving means having:

a fuel circulation pipe branched from the feed pipe at an

intermediate point thereof and connected to the fuel tank;

feed pipe opening/closing means provided in the feed pipe on a side downstream of the feed pump in a flowing direction of the liquefied gas fuel, and operative to open and close a flow passage of the feed pipe; and

an aspirator provided in the fuel circulation pipe and having a suction port disposed to communicate with the fuel gallery and/or the overflow fuel pipe,

the remaining fuel retrieving means being constructed to circulate the liquefied gas fuel delivered from the feed pump, to the fuel tank via the feed pipe, the fuel circulation pipe and the aspirator in the state of cutting off supply to the injection pump by closing the feed pipe opening/closing means, and suck and retrieve the liquefied gas fuel remaining in the fuel gallery and the overflow fuel pipe, to the fuel tank by suction force produced in the suction port of the aspirator on the basis of the circulation,

the suction port of the aspirator being disposed at a position lower than the fuel gallery and the overflow fuel pipe.

3. A liquefied gas fuel supply device for a diesel engine according to claim 2, characterized by further comprising a check valve disposed between a position where the fuel circulation pipe is branched from the feed pipe and the feed pipe opening/closing means, and operative to prevent liquefied gas fuel from flowing back from the injection pump, and fuel circulation pipe opening/closing means provided in the fuel circulation pipe and operative to open and close a flow passage of the fuel circulation pipe.

4. A liquefied gas fuel supply device for a diesel engine characterized by comprising:

a feed pump for pressurizing liquefied gas fuel in a fuel tank to a predetermined pressure and delivering the liquefied gas fuel to a feed pipe;

an injection pump for delivering the liquefied gas fuel in a fuel gallery into which the liquefied gas fuel delivered via the feed pipe flows, to an injection nozzle of a diesel engine by a predetermined amount at predetermined timing;

an overflow fuel pipe for returning to the fuel tank the liquefied gas fuel which overflows from the injection pump; and

remaining fuel retrieving means for retrieving to the fuel tank the liquefied gas fuel remaining in the fuel gallery and the overflow fuel pipe,

after the stop of the diesel engine,

the remaining fuel retrieving means having:

a fuel circulation pipe branched from the feed pipe at an intermediate point thereof and connected to the fuel tank;

feed pipe opening/closing means provided in the feed pipe on a side downstream of the feed pump in a flowing direction of the liquefied gas fuel, and operative to open and close a flow passage of the feed pipe; and

an aspirator provided in the fuel circulation pipe and having a suction port disposed to communicate with the fuel gallery and/or the overflow fuel pipe,

the remaining fuel retrieving means being constructed to circulate the liquefied gas fuel delivered from the feed pump, to the fuel tank via the feed pipe, the fuel circulation pipe and the aspirator in the state of cutting off supply to the injection pump by closing the feed pipe opening/closing means, and suck and retrieve the liquefied gas fuel remaining in the fuel gallery and the overflow fuel pipe, to the fuel tank by suction force produced in the suction port of the aspirator on the basis of the circulation,

the remaining fuel retrieving means further including:

fuel circulation pipe opening/closing means provided in the fuel circulation pipe and operative to open and close a flow passage of the fuel circulation pipe; and

a check valve disposed between a branch point between the feed pipe and the fuel circulation pipe and the feed pipe opening/closing means, and operative to prevent liquefied gas fuel from flowing back from the injection pump.

5. A liquefied gas fuel supply device for a diesel engine according to any one of claims 1 to 4, characterized by further comprising a vapor-phase pressure delivery pipe connecting an inlet for liquefied gas fuel in the injection pump and a vapor phase in the fuel tank, and vapor-phase pressure delivery pipe opening/closing means for opening and closing the vapor-phase pressure delivery pipe.

6. A liquefied gas fuel supply device for a diesel engine according to claim 5, characterized in that the vapor-phase pressure delivery pipe opening/closing means is disposed at a position higher than an area in the injection pump in which the liquefied gas fuel remains.

7. A liquefied gas fuel supply device for a diesel engine according to any one of claims 1 to 4, characterized by including a construction in which the liquefied gas fuel delivered from the injection pump is supplied to a common rail and is delivered to each fuel injection nozzle from the common rail, and further comprising a vapor-phase pressure delivery pipe connecting the common rail and a vapor phase in the fuel tank, and vapor-phase pressure delivery pipe opening/closing means for opening and closing the vapor-phase pressure delivery pipe.

8. A liquefied gas fuel supply device for a diesel engine according to claim 7, characterized in that the vapor-phase delivery pipe opening/closing means is disposed at a position higher than the common rail.

9. A liquefied gas fuel supply device for a diesel engine according to any one of claims 1 to 4, characterized by including a construction in which the liquefied gas fuel delivered from the injection pump is supplied to a common rail and is delivered to each fuel injection nozzle from the common rail, and further comprising a vapor-phase pressure delivery pipe connecting an inlet of the fuel injection nozzle and a vapor phase in the fuel tank, and vapor-phase pressure delivery pipe opening/closing means for opening and closing the vapor-phase pressure delivery pipe.

10. A liquefied gas fuel supply device for a diesel engine according to claim 9, characterized in that the vapor-phase pressure delivery pipe opening/closing means is disposed at a position higher than the fuel injection nozzle.

11. A liquefied gas fuel supply device for a diesel engine according to claim 2 or 4, characterized by further comprising: an oil separator for separating the liquefied gas fuel mixing with a lubricating oil in a cam chamber of the injection pump which is a dedicated lubricating system separated from a lubricating system for a diesel engine; a compressor for pressurizing the liquefied gas fuel separated by the oil separator and delivering the liquefied gas fuel to the fuel tank; a low-pressure tank connected to a suction port of the compressor; a purge pipe causing the low-pressure tank and the overflow fuel pipe to communicate with each other; and purge pipe opening/closing means capable of opening and closing the purge pipe.

12. A liquefied gas fuel supply device for a diesel engine according to claim 11 characterized in that a check valve for holding pressure in the low-pressure tank is disposed between the compressor and the low-pressure tank.

13. A liquefied gas fuel supply device for a diesel engine according to claim 11, characterized in that the remaining fuel retrieving means includes: the feed pipe opening/closing means and the fuel circulation pipe opening/closing means for switching a delivery port of the feed pipe to either one of an inlet of a circulation passage of the aspirator and an inlet of the fuel gallery and causing the delivery port to communicate with the either one; suction port opening/closing means for opening and closing communication between the suction port of the aspirator and the fuel gallery as well as the overflow fuel pipe; and a liquefied gas fuel retrieving control section capable of executing control to switch communication provided by each of the feed pipe opening/closing means and the fuel circulation pipe opening/closing means to the inlet of the aspirator, open the suction port opening/closing means, and form a flow passage through which the liquefied gas fuel delivered from the feed pump is to be circulated to the fuel tank, as well as control to open the vapor-phase pressure delivery pipe opening/closing means and, after the lapse of a predetermined time, close only the vapor-phase pressure delivery pipe opening/closing means.

14. A liquefied gas fuel supply device for a diesel engine according to claim 13, characterized in that the liquefied gas fuel retrieving control section is constructed to be able to execute control to open the purge pipe opening/closing means after closing the suction port opening/closing means.

15. A liquefied gas fuel supply device for a diesel engine according to claim 3 or 4, characterized in that the remaining fuel retrieving means includes: feed pipe opening/closing means for opening and closing communication of the feed pipe on the same side as the injection pump with respect to the branch point between the feed pipe and the fuel circulation pipe; fuel circulation pipe opening/closing means for opening and closing an inlet of the aspirator; suction port opening/closing means for opening and closing a communication pipe between the suction port of the aspirator and the fuel gallery as well as the overflow fuel pipe; and a

liquefied gas fuel retrieving control section for executing control to open and close the feed pump, the feed pipe opening/closing means, the fuel circulation pipe opening/closing means, and the suction port opening/closing means,

the liquefied gas fuel retrieving control section being constructed to be able to execute, after the stop of a diesel engine, control to close the feed pipe opening/closing means and cut off supply of liquefied gas fuel to the fuel gallery, and control to circulate the liquefied gas fuel delivered from the feed pump to the fuel tank via the fuel circulation pipe while causing the suction port of the aspirator to communicate with the fuel gallery as well as the overflow fuel pipe, by executing control to open the fuel circulation pipe opening/closing means and the suction port opening/closing means.

16. A liquefied gas fuel supply device for a diesel engine according to claim 15, characterized in that the liquefied gas fuel retrieving control section is constructed to be able to execute control to hold the liquefied gas fuel in the state of being charged in the feed pipe between the feed pipe opening/closing means and the check valve, while continuing control to close the feed pipe opening/closing means, after having retrieving to the fuel tank the liquefied gas fuel remaining in the fuel gallery and the overflow fuel pipe.

17. A liquefied gas fuel supply device for a diesel engine according to claim 15, characterized in that in the remaining fuel retrieving means, the aspirator and the fuel circulation pipe opening/closing means are disposed immediately close to the fuel tank.

18. A liquefied gas fuel supply device for a diesel engine according to claim 15, characterized in that in the remaining fuel retrieving means, the feed pipe opening/closing means is disposed in the feed pipe in the vicinity of an inlet of the fuel gallery, and the check valve is disposed immediately close to the branch point between the feed pipe and the fuel circulation pipe.

19. A liquefied gas fuel supply device for a diesel engine according to claim 5, characterized in that the liquefied gas fuel retrieving control section is constructed to be able to execute control to open the vapor-phase pressure delivery pipe opening/closing means and deliver vapor-phase

pressure in the fuel tank to the fuel gallery and the overflow fuel pipe.

20. A liquefied gas fuel supply device for a diesel engine according to claim 11, characterized in that the liquefied gas fuel retrieving control section is constructed to be able to execute, after the stop of a diesel engine, control to close the feed pipe opening/closing means and cut off supply of liquefied gas fuel to the fuel gallery, and execute, after stopping the feed pump with the suction port opening/closing means closed, control to open the purge pipe opening/closing means and suck the liquefied gas fuel remaining in the fuel gallery and the overflow fuel pipe to the low-pressure tank.